developed singer of all, this quality can be found as well as rhythm and invention. Whether we agree with him or not in some of these details, it is a pleasure to be able to say with confidence that all he writes deserves careful study, for which every conscientious ornithologist will be the better.

The only thing that seems wanting is a discussion of the *quality* of tone (not quantity) in various species. Thus the formal likeness between the songs of the chaffinch and the willow-wren is noticed (p. 31), but nothing is said of the fact that they are produced by totally different instruments. To the ear of the present writer the songs of both species of redstart are "played" on an instrument which no other bird possesses. We would suggest that Dr. Hoffmann should add a section on this subject in another edition, and shorten, if need be, the discussion at the end of the volume on the use made by musical composers of the songs of birds, which is only of incidental interest. Before leaving this interesting work, which well merits translation into English, it may be as well to say that the author is disposed to reject Darwin's theory of the development of song by sexual selection, and to hold that the root of it is to be found in the enjoyment of life and the love of play, especially, but not entirely, in the breeding season.

W. W. F.

OUR BOOK SHELF.

The Scientific Aspects of Luther Burbank's Work. By D. S. Jordan and V. L. Kellogg. Pp. xiv+115. (San Francisco: A. M. Robertson, 1909.) Price 2 dollars net.

THIS is a small book, consisting of two papers reprinted from the *Popular Science Monthly,* describing and appreciating the work of the great American plant-breeder. It is attractively illustrated by photographs, and is intended for the general as well as the scientific reader.

Luther Burbank was born in 1849, and after a local education started life in his uncle's plough factory. He soon gave this up for market gardening, and in 1875 moved to Santa Rosa, California, where he has since worked on a large scale, and produced many new and important varieties, both of fruits and flowers. He has discovered no new laws, but his results are so obviously successful that it is interesting to know the methods by which they have been obtained. Like most practical men, he is a firm believer in the heritability of the direct effects of environment, but he makes most use of the indirect ones—the "indefinite variations" of Darwin—and recognises as their chief cause the re-combination of characters consequent on hybridisation, and, in a lesser degree, on cross- or self-fertilisation.

The first step in the method usually followed is the inducing of these variations by nutritive changes or by the crossing of forms as widely separated as is compatible with fertility. The useful variations are then accumulated by stringent selection until they become fixed. Mr. Burbank finds that six generations are generally sufficient to accomplish the process. He holds that there is practically no limit to the results which can be obtained by unassisted selection, and many of his size and colour varieties of flowers have been obtained by this method alone. Sometimes, on the other hand, a new variety is produced by the careful propagation, without much selection, of one individual which showed a fortunate mutation. The Burbank stoneless plum is an example of the effective combination of the three processes of searching for natural mutations, hybridising, and selection. A plum was found in a small wild species with only part of a stone. This species was crossed with the French prune, and some of the offspring found to be quite stoneless. Further selection is still increasing the proportion of stoneless, and at the same time large, fruits. The desirable qualities of two varieties can generally be combined by crossing; indeed, some of the offspring often possess a quality in a higher degree than either of their parents. Some of the photographs illustrating the increase of size in fruits show this in a striking manner.

We do not for a moment doubt that Mr. Burbank has "a broad intelligence and a sensitive soul." If he is also "as sweet, straightforward, and as unspoiled as a child," it is just possible that he can stand being told so. But his portrait is so singularly charming that it might have been left to speak for itself.

Text-book of Petrology, containing a Summary of the Modern Theories of Petrogenesis, a Description of the Rock-forming Minerals, and a Synopsis of the Chief Types of the Igneous Rocks and their Distribution, as illustrated by the British Isles. By Dr. F. H. Hatch. Fifth edition, revised and rewritten. Pp. xvi+404. (London: Swan Sonnenschein and Co., Ltd., 1909.) Price 7*s*. 6*d*. net.

THIS new edition of a well-known text-book for students marks a decided advance on its predecessors. It is clearly written, well illustrated, and has, as a rule, been brought up to date.

There is a brief but readable account of the eutectic theory of the process of crystallisation of igneous rocks, as well as of the different explanations which have been offered of the formation of porphyritic crystals.

The descriptions of the rock-forming minerals are in most respects accurate and sufficient. The author disclaims any intention of dealing with the optical determination of minerals, but as he makes use of the interference colours for the purpose of estimating the birefringence, he might with advantage have gone a little further and shown how easily an approximate quantitative determination of the relative retardation and birefringence may be made. Such expressions as "weak," "moderate," "very strong," "polarising in grey tints," "brilliant chromatic polarisation," though commonly employed, have very little scientific value, especially when the variation in thickness of rock-slices, even by good makers, is considered. In the same way, if the angle of extinction be employed for determinative purposes, the student should be taught to discriminate between the positive (slow) and negative (fast) directions of extinction. The statement that "between crossed nicols the rhombic pyroxenes extinguish of course straight" is too sweeping. Certain directions of section show quite an appreciable angle of extinction.

The author adopts analytical formulæ for the rock-forming minerals, a procedure which is justified by the clearness with which the composition is indicated and the ease with which it is remembered, but it may be noted that the abbreviation "Ab" for albite represents, not $Na_2O.Al_2O_3.6SiO_2$ as stated, but half that formula.

The primary classification of igneous rocks into plutonic, hypabyssal and volcanic, which is adopted, is sanctioned by almost universal usage, though it is as unreasonable as a fundamental division of the vegetable kingdom into roots, stems, and leaves. Each class of rocks is separated into families and types,

with the definition of which little serious fault is, in most cases, to be found, though there may often be room for difference of opinion.

Perhaps the most valuable feature is the section which describes the distribution of igneous rocks in the British Isles, and the maps, mostly taken, by permission, from well-known papers, with which it is illustrated.

The work may be safely recommended as a text-book for students, but they should be warned against the employment of the numerous little-known and unnecessary rock-names to be found in its pages. In almost every case the same idea can be more happily expressed by prefixing a word or phrase to a well-established name. Their presence, however, undoubtedly increases the value of the book as a work of reference. J. W. E.

Catalogue of the Lepidoptera Phalaenae in the British Museum. Vol. vii. Catalogue of the Noctuidæ in the Collection of the British Museum. By Sir George F. Hampson, Bart. Pp. xv+709; plates cviii–cxxii; 184 text-figures. (London: Printed by Order of the Trustees, 1908.)

IN no group of animals and plants is the enormous increase in our knowledge more conspicuous than in insects. Thus, at the time of the publication of the twelfth edition of Linné's "Systema Naturæ" (1767), we find only 112 species described under Noctuæ. Sir George Hampson now divides the family Noctuidæ into fifteen families, of which the first three are Agrotinæ, Hadeninæ, and Cucullianæ, the species belonging to each being described in vols. iv.–vi. of the general "Catalogue of Moths" respectively, and vol. vii., now before us, forms the first of three volumes intended to be devoted to the fourth sub-family of Noctuidæ, the Acronyctinæ, and includes descriptions of species numbered from 2748 to 3590, a considerable number of which (and also many genera) are described as new by the author.

It is possible that all the remaining families of Noctuidæ may not require a whole volume apiece, and it would be difficult to estimate the total number of Noctuidæ which the present work is likely to contain when completed, but it can scarcely be less than 20,000 species, and may well be 30,000, or even more, as against the 112 species which were all that were known to Linné, the most learned entomologist of his time, in 1767.

We notice no alteration in the general arrangement of the work, and the usual high standard of letter-press and illustrations is fully maintained in the present volume.

Physikalische Musiklehre. Eine Einführung in das Wesen und die Bildung der Töne in der Instrumentalmusik und im Gesang. By Dr. Hermann Starke. Pp. viii+232. (Leipzig: Quelle and Meyer, 1908.) Price 3.80 marks.

THIS little work on the physical theory of the nature and production of musical sounds is almost entirely free from mathematics, and may be regarded for the most part as an abstract of the simpler portions of Helmholtz's great classic, "The Sensations of Tone." The text is, however, freely illustrated by cuts, many of which, the author acknowledges, are borrowed from other books; thus at every few pages may be found an old and familiar figure.[1]

The treatment is divided into five parts or chapters. Of these the first and second are occupied with the origin and propagation of waves and sound, while the third describes musical tones, intervals, and scales. The fourth chapter consists of four parts, dealing respectively with (i.) stringed instruments, (ii.) wind instruments, (iii.) vibrating bodies with inharmonic overtones, and (iv.) human speech and song. The last chapter is devoted to consonance and dissonance, and after giving Helmholtz's theory concludes with a *résumé* of more recent work on the subject. This part includes notices of intermittence and variation tones, and of the work and theories of C. Stumpf.

To those who wish for a bright, readable treatment of this borderland between music and physics, free from mathematics, but with the opportunity of improving their conversance with German, this book is heartily recommended. E. H. B.

[1] Perhaps it is this practice which has led to the representation of a metal *strip* vibrating like a *string* (p. 22), for the same error occurs in Tyndall's "Sound" (p. 128), 1895.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Electrons and the Absorption of Light.

ON the theories of dispersion given by Drude and Lorentz, an absorption band in the spectrum corresponds to the free period of an electron, and, if we assume that only one electron in each molecule is concerned with an absorption band, it is theoretically possible to calculate e/m for this electron from the values of the coefficient of extinction throughout the band. I have made this calculation, apparently for the first time, using the formula

$$\frac{e}{m} = 1{\cdot}297\, \nu\kappa \frac{\lambda_1 - \lambda_0}{\lambda_0^{\,3}},$$

which may be derived on both the above theories. κ is the maximum value of the coefficient of extinction, λ_0 the position of the maximum, λ_1 the wave-length, for which the coefficient of extinction has a value equal to half its maximum, and ν the index of refraction. The following table gives some results:—

Substance	λ_0	e/m	Source of data
	$\mu\mu$		
Fuchsin in alcohol...	550	1·8 10^7	
Phloxin in water	515	1·4 10^7	Stanislaw Kalandek
Crystal violet in alcohol ...	575	4·9 10^7	*Phys. Zeit.*, 9 Jahr., s. 128–35
Corallin in alcohol	465	1·6 10^6	
Methylene blue in water ...	665	5·4 10^6	
Water blue in water	575	8·1 10^6	
Eosin in water	515	6·9 10^6	
Eosin in water	516	9·2 10^6	Georg. J. Katz
Cyanine in alcohol	587	5·8 10^6	Inaug. diss., Erlangen, 1898
Cobalt chloride in water ...	504	2·5 10^3	Houstoun and Russell
Uranyl nitrate in water ...	486	34	Proc. Roy. Soc. Edin., vol.
	473	75?	xxix., part ii., p. 68
Three glasses coloured with CoO	644	5·0 10^4	R. Zsigmondy, *Ann. d.*
	631	3·0 10^4	*Phys.* (4), 4, 1901, s. 60
	640	3·0 10^4	Figures taken from curves
Two glasses coloured with Cr_2O_3	620	3·2 10^4	
	655	1·2 10^4	
Three glasses coloured with NiO	640	1·3 10^4	
	640	1·0 10^4	
	610	1·1 10^4	

For the anilin colouring matters e/m is of the order 10^7, whereas for the glasses and inorganic salts it is of the order 10^4 and under, showing that in the one case we are dealing with electrons and in the other with ions. A calculation made by Drude from the dispersion of solid cyanine in the neighbourhood of its band gave $e/m = 8{\cdot}5 \times 10^6$. If there are two electrons for each of the original molecules of the colouring matter the values of e/m should be halved, or if there is only one electron for two molecules the value of e/m should be doubled. According to Kalandek, corallin probably undergoes some change in solution. This may account for the low value of e/m.